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PROGRAMMABLE MOBILE DEVICE WITH THUMB WHEEL

by

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PROGRAMMABLE MOBILE DEVICE WITH THUMB WHEEL

TECHNICAL FIELD

The present invention relates generally to programmable mobile terminals. More particularly, the present invention relates to a programmable mobile terminal which includes a thumb wheel for selecting among a plurality of functions executable by the mobile terminal.

BACKGROUND OF THE INVENTION

In recent years, the use of wireless communication systems having mobile transceivers which communicate with a hardwired network, such as a local area network (LAN) or a wide area network (WAN), has become widespread. The mobile transceivers, commonly referred to as mobile terminals, may take one of several different forms. For instance, in retail stores hand-held scanning units may be used to allow for scanning inventory bar codes. In a warehouse, portable units mounted to a vehicle may be used to gather information from the warehouse floor. In a medical environment, the mobile terminal may take the form of a pen based workslate which allows medical personnel to work with full page screens.

In a typical wireless communication system, each mobile terminal communicates with a networked system via a radio or optical link in order to allow for a real time exchange of information. The mobile terminals communicate through one of several base stations interconnected to the network. The base stations allow for a wireless data communication path to be formed. Consequently, such mobile terminals significantly facilitate worker efficiency since data can be gathered, transmitted and even processed at a remote site in real time.

However, despite the aforementioned advantages associated with mobile terminals, there is a strong need for a more ergonomic mobile terminal. For example, mobile terminals are typically held in one hand and a user has to use the other hand to scroll through functions and select a function. Thus, both hands are usually occupied at one time or another when using a mobile terminal. As a result, a user is physically limited by such conventional mobile terminals since the user would have to cease interaction with the mobile terminal to free at least one hand to accomplish another task such as taking a patients temperature, writing on a piece of paper, using the telephone, etc.

In view of the aforementioned drawbacks associated with conventional mobile terminals; there is a strong need in the art for a mobile terminal which eliminates or at least reduces the need for a user to use both hands while employing a mobile terminal.

SUMMARY OF THE INVENTION

The present invention relates to programmable mobile terminal in which a thumb wheel is employed to select among a plurality of functions executable by the mobile terminal. The programmable mobile terminal, as a result of the thumb wheel, affords a user to employ the same hand that is holding the mobile terminal to scroll through and select a function among a plurality of functions. The wheel portion of thumb wheel is rotated either clockwise or counter clockwise by the user's thumb or other finger to scroll a screen cursor through the functions and once the screen cursor of the mobile terminal is positioned at a desired function, the user can depress the wheel portion in a transaxial direction with the same thumb or finger to select the desired function. As a result, the thumb wheel allows a user to hold and also interact with the mobile terminal with only one hand thus freeing his or her other hand for other purposes.

In accordance with one particular aspect of the invention, a mobile device for use in a cellular communication system is provided, the mobile device including: a housing; a user programmable processor within the housing; thumb wheel extending from the housing, the thumb wheel including: a wheel portion rotatable about an axis; and a control circuit operatively coupled to the thumb wheel, wherein the control circuit provides at least one signal to the processor in response to movement of the wheel portion.

According to another aspect of the invention, a method of selecting among a plurality of functions executable by a user programmable mobile terminal is provided, including the steps of: using an interrupt generator to monitor a thumb wheel for movement of a wheel portion of the thumb wheel; using the interrupt generator to generate an interrupt request upon movement of the wheel portion, and sending the interrupt request to an interrupt handler; using the interrupt handler to inform a processor that an interrupt relating to movement of the wheel portion has occurred; using the processor to determine what type of wheel portion movement has occurred, wherein the processor relates a particular wheel portion movement to at least one of the plurality of functions executable by the programmable mobile terminal; and using the processor to perform a routine corresponding to the at least one of the plurality of functions executable by the programmable mobile terminal.

According to still another aspect of the invention, a mobile device is provided, comprising: a housing; a user programmable processor within the housing, wherein the processor can receive, store and execute programs input thereto by the user; a scanner; and a thumb wheel received within the housing, the thumb wheel including a wheel portion, an encoding device and a control circuit, wherein: the wheel portion is rotatable about an axis and transaxially moveable; the encoding device produces at least one signal indicative of movement of the wheel portion; and the control circuit is coupled to the encoding device for receiving the at least one signal from the encoding device and outputting a signal to the processor in response thereto, wherein the processor performs a particular routine among a plurality of routines executable by the processor in response to the signal output by the control device.

According to yet another aspect of the invention, a mobile device for use in a cellular communication system is provided, the mobile device including: a portable housing; a user programmable processor within the housing; a bar code reader coupled to the processor for reading bar code information; a thumb wheel extending from the housing, the thumb wheel including: a wheel portion rotatable around an axis; and a control circuit operatively coupled to the thumb wheel, wherein the control circuit provides at least one signal to the processor in response to movement of the wheel portion.

To the accomplishment of the foregoing and related ends, the invention, then comprises the features hereinafter fully described and particularly pointed out in the claims. The following description and the annexed drawings set forth in detail certain illustrative embodiments of the invention. These embodiments are indicative, however, of but a few of the various ways in which the principles of the invention may be employed. Other objects, advantages and novel

features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a mobile terminal having a thumb wheel in accordance with the present invention;

FIG. 2 is a block diagram of a mobile terminal in accordance with the present invention;

FIG. 3 is a front schematic view of the thumb wheel including an encoding device according to the present invention;

FIG. 4 is an equivalent circuit representing switches of the thumb wheel according to the present invention;

FIG. 5 is a circuit diagram of the thumb wheel and associated circuitry according to the present invention;

FIG. 6 is a timing diagram illustrating the phase difference between the output signals "A" and "B" of the thumb wheel when rotated in a clockwise or counter clockwise direction, respectively, according to the present invention;

FIG. 7 is a system flowchart suitable for programming the mobile terminal to determine movement of the thumb wheel, and to perform a particular routine corresponding to the movement of the thumb wheel in accordance with the present invention;

FIGS. 8A–8E represent various screen displays of functions executable by the mobile terminal and which can be selected by a user via the thumb wheel in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will now be described with reference to the drawings wherein like reference numerals are used to refer to like elements throughout.

As is mentioned above, the present invention relates to a programmable mobile terminal (e.g., a portable teletransaction computing device (PTC)) in which a thumb wheel is employed to select among a plurality of functions executable by the device (PTC). In the exemplary embodiments described hereinafter, each PTC is a hand held inventory control device used to communicate data such as inventory or the like within a cellular, narrow band or other radio communication system including multiple mobile terminals and base stations. However, it is recognized that the present invention contemplates other types of programmable mobile terminals or devices and is not intended to be limited necessarily to hand held inventory control devices or devices which must wirelessly communicate information.

Referring initially to FIG. 1, a mobile terminal **10** is shown in accordance with the present invention. The terms "mobile terminal" and "PTC" are used interchangeably throughout the specification. The mobile terminal **10** includes a portable housing **12** which is preferably made of metal, high strength plastic, or the like. The mobile terminal **10** includes a thumb wheel **13** partially exposed through the housing **12**. In addition, the mobile terminal **10** includes a display **14** such as a liquid crystal display or the like. As is conventional, the display **14** functions to display data or other information relating to ordinary operation of the mobile terminal **10** in a cellular communication system. For example, the display **14** may display inventory information, pricing detail, etc. which is to be transmitted to or is received from a system backbone. Additionally, the display **14** may display a variety of functions that are executable by the mobile terminal **10**.

The mobile terminal **10** further includes an operator input device **18** in the form of a key pad which enables a user to enter data, information, function commands, etc. as is conventional. For example, the user may input information relating to inventory via the keypad **18** for subsequent transmission to a base station (not shown). In addition, the keypad **18** includes up and down cursor keys **20*a*** and **20*b***, respectively, for controlling a cursor which may be shown on the display **14**. By selectively pressing the up and down cursor keys **20*a*** and **20*b***, the user is able to move the cursor about the display **14**. Furthermore, the key pad **18** includes a select key **20*c*** for selecting an item or function designated by the cursor.

The thumb wheel **13** can accomplish many of the same tasks as the combination of the cursor keys **20*a*** and **20*b*** and the select key **20*c***. For instance, the wheel portion **13*a*** (FIG. 3) of the thumb wheel **13** can be rotated manually by the user either clockwise or counter clockwise to move the cursor up or down like the cursor keys **20*a*** and **20*b***. The thumb wheel **13**, like the select key **20*c***, also can be used to select an item or function designated by the cursor by simply pressing the wheel portion **13*a*** transaxially in an inward direction toward the housing **12** of the mobile terminal **10**. As is discussed more fully below, the thumb wheel **13** exhibits a push button action when pressed in a direction normal to the axis of rotation of the thumb wheel **13**.

As a result, a user by employing the thumb wheel **13** can accomplish many tasks involving the mobile terminal **10** with only one hand (the hand holding the mobile terminal **10**). For example, a nurse holding a mobile terminal **10** (adapted and user programmed for operation in a medical environment) could possibly manipulate data and information or select among a variety of functions available by the mobile terminal **10** using the one hand holding the mobile terminal **10**. With the mobile terminal **10** seated in the palm of the nurse's hand, the nurse may use her thumb to rotate and depress the thumb wheel **13** in order to pull up a patient's chart. Thus, the nurse's other hand can be free to perform other tasks such as taking a patient's temperature, using a telephone, etc.

Referring again to FIG. 1, the mobile terminal **10** also includes a bar code reader **22** in the form of a wand or the like which allows information to be input to the mobile terminal **10** via bar code symbols. The bar code reader **22** is coupled to the housing **12** by a cable **24** which provides the appropriate electrical connections between the bar code reader **22** and the circuitry contained in the housing **12**.

Extending from the housing **12** is an antenna **28** for transmitting and receiving radio signals within a cellular communication system. In the exemplary embodiment, the antenna **28** is an omnidirectional antenna but other types of antennas are equally possible. A speaker **29** is integral to the housing **12** and provides an audial output for the user. Additionally, the mobile terminal **10** includes a PCMCIA card slot for receiving a PCMCIA card. As mentioned above, the mobile terminal **10** is user programmable and thus a user can input commercial or user created software to tailor the mobile terminal **10** to execute desired functions. However, it is understood that this invention is not limited to inputting functions, instructions or data via PCMCIA card, and that any suitable means for a user to input functions, instructions or data to the mobile terminal **10** falls within the scope of the this invention.

Referring now to FIG. 2, a block diagram of the electronic circuitry within the mobile terminal **10** is shown. As noted above, the mobile terminal **10** includes an antenna **23** for

receiving and transmitting signals via a transceiver 40 to which it is connected. The transceiver 40 is coupled via a control/data bus 42 to a processor 44 included in the mobile terminal 10. The processor 44 is responsible for controlling the general operation of the mobile terminal 10 with respect to processing and storing information received and transmitted by the transceiver 40. The processor 44 is programmed to control and to operate the various components within the mobile terminal 10 in order to carry out various functions described herein. The operator input device 18 is coupled to the processor 44 which allows an operator to input data to be communicated to a system backbone (not shown) or local computer (not shown) such as inventory data, ordering information, and the like. The input device 18 can include such items as the aforementioned keypad, touch sensitive display, etc. The mobile terminal 10 also includes the bar code reader 22 coupled to the processor 44 for providing another form of data input.

The display 14 is connected to and controlled by the processor 44 via a display driver circuit 46. A memory 50 is included in the mobile terminal 10 for storing program code executed by the processor 44 for carrying out operating functions of the mobile terminal 10 as described herein. The memory 50 may also serve as a storage medium for temporarily storing information received from or intended to be transmitted to a base station (not shown) or a local computer (not shown).

A power supply 52 is also included in the mobile terminal 10 for providing power to the various components of the mobile terminal 10 as is conventional. The power supply 52 may be in the form of a battery and/or connectable to an external power source such as a wall outlet.

With the exception of the antenna 28, the components making up the mobile terminal 10 are preferably housed in a palm-sized housing 12 represented in phantom. This makes the mobile terminal 10 highly portable and easy to carry from one cell to another within a cellular system.

The thumb wheel includes an encoder 62 for discerning displacement of the wheel portion 13*a* of the thumb wheel 13. The thumb wheel 13 allows an operator to perform many of the same functions as the operator input device 18 such as scrolling up and down through items or functions displayed on the screen 14 and/or selecting a particular item or function displayed on the screen 14. The thumb wheel 13 is coupled to the processor 44 by both an I/O port 60 and via an interrupt generator 64 which is tied to an interrupt handler 66 which is coupled to the processor 44.

The thumb wheel 13 has outputs A, B and SW, respectively corresponding to the "A" signal, "B" signal and the transaxial switch "THAN" signal 25 are discussed more fully below. These outputs are coupled to both the interrupt generator 64 and an input/output port 60. The interrupt generator 64 serves to generate a system interrupt signal (IRQ) in response to rotational or transaxial movement of the wheel portion 13*a* based on a change in the A, B or transaxial switch signals. The interrupt handler 66 processes interrupts generated by the interrupt generator 64, and informs the processor 44 that an interrupt has occurred. Additionally, as is conventional, the interrupt handler 66 may receive interrupt signals from other devices within the mobile terminal 10 such as the display driver 46, bar code reader 22, operator input device 18, etc. However, for sake of brevity, further elaboration on this aspect of the interrupt handler 66 is not presented.

The I/O port 60 serves to allow the processor to determine in what way the wheel portion 13*a* has moved (e.g., clockwise, counter clockwise and/or transaxially) upon receiving notice from the interrupt handler 66 that a system interrupt has been generated by the interrupt generator 64 in response to movement of the wheel portion 13*a*. The processor 44 determines how the wheel portion 13*a* has moved by evaluating the phase difference between signals "A" and "B" with respect to rotational movement. The processor 44 determines if the wheel portion 13*a* has moved transaxially by determining if SW is closed. The process of determining movement of the wheel portion 13*a* is explained in greater detail below.

Referring now to FIG. 3, the thumb wheel 13 is illustrated in greater detail. The thumb wheel 13 in the exemplary embodiment is an ED Jog Encoder Part Number EVQWK6Z01 sold by Panasonic Industrial Company, Standard Components Division, 1707 North Randall Road, Elgin, Ill. 60123-7847. However, it is understood that any suitable thumb wheel can be employed for the purposes of this invention. For example, it will be appreciated that a thumb wheel employing an optical encoder would fall within the scope of the present invention.

The thumb wheel 13 has 15 detents (not shown) circumferentially spaced along the perimeter of the wheel portion 13*a*. The detents are spaced equidistance apart to create respective detent angles of 24°. The wheel portion 13*a* is rotatable about its central axis A1 in either a clockwise or counter clockwise direction as shown respectively by arrows "A" and "B". The wheel portion 13*a* can be rotated indefinitely in either the "A" or "B" direction. That is, the wheel portion 13*a* can be continuously turned in one direction. This feature can be utilized by the processor 44 to move the screen cursor down the display, for example, when the screen cursor reaches the bottom of the screen, it may appear at the top of the screen upon further rotation of the wheel portion 13*a* in the same direction.

The wheel portion 13*a* is also transaxially moveable in the directions "C" and "D". For example, the wheel portion 13*a* is moved transaxially by a user in the "C" direction to select a function designated on the screen 14 by the cursor. A bulbous spring button 84 is coupled to the wheel portion 13*a* of the thumb wheel 13 and is biased to return via direction "D" the wheel portion 13*a* of the thumb wheel 13 to a non-select position. Thus, once a user selects an item or function by depressing the wheel portion 13*a*, the spring button 82 returns the wheel portion 13*a* back to a select position. The spring button 82 distorts upon transaxial force exerted on the thumb wheel 13. Accordingly, when a user exerts transaxial force in generally the direction "C", the spring button 84 is distorted. The spring button is always in contact with contact SW2 of the transaxial switch 90 (FIG. 4). The transaxial switch 90 corresponds to transaxial movement of the wheel portion 13*a*. When the spring button 84 is distorted by transaxial pressure it comes into contact with either or both SW1 contacts of the transaxial switch 90, and thus closes the transaxial switch 90. There are two SW1 contacts (located on either side of SW2) in the transaxial switch 90 for sake of redundancy.

The processor 44 can thus determine whether the wheel portion 13*a* has been moved transaxially by determining whether the transaxial switch 90 is open or closed. If the switch 90 is "open", the wheel portion 13*a* has not been moved transaxially. If the switch 90 is "closed", the wheel portion 13*a* has been moved transaxially.

FIG. 4 also illustrates switch$_A$ 92 and switch$_B$ 94, which correspond to clockwise and counter clockwise rotation of the wheel portion 13*a*, respectively. The direction of rotation

of the wheel portion **13a** is determined by comparing the phase difference between the "A" signal and "B" signal output from the encoder circuit **100** (FIG. **5**). The measuring circuit **100** works in the following manner. Either $switch_A$ **92** or $switch_B$ **94** closes for every 6° of movement of the wheel portion **13a**. The 6° results from the fact that there are 15 detents, providing **15** detent angles which each correspond to 24° of movement of the wheel portion **13a**. Since 24° of movement of the wheel portion **13a** corresonds to one period of either the "A" signal or "B" signal, 6° of movement of the wheel portion **13a** corresponds to one quadrant of the "A" signal or "B" signal.

Referring now to FIG. 5, the encoding circuit **100** is shown to include a voltage source V_{cc} which is tied to a first end of resistors R_2, R_3 and R_5. A first end of $Switch_A$ **92** is connected to a node "C" between resistors R_1 and R_2. An other end of $switch_A$ **92** is tied to a common ground COM. An other end of R_1 is connected to a first end of capacitor C_1. An other end of C_1 is connected to COM. The "A" signal is output from a node connecting R_1 and C_1. Similarly a first end of $switch_B$ **94** is connected to a node "D" between resistors R_3 and R_4. An other end of $switch_b$ **94** is tied to a common ground COM. An other end of R_4 is connected to a first end of capacitor C_2. An other end of C_2 is connected to COM. The "B" signal is output from the node connecting R_4 and C_2. Likewise, a first end of the transaxial switch **90** is connected to the node between resistors R_5 and R_6. An other end of the transaxial switch **90** is tied to dual contacts SW1 which are tied to COM. An other end of R_6 is connected to a first end of capacitor C_3. The other end of C_3 is connected to COM. The transaxial signal "TRAN" is output from a node connecting R_6 and C_3. The values for the various resistors and capacitors of the encoder circuit **100** can be varied according to the desired operational parameters of the thumb wheel **13**.

The encoder circuit **100** works in the following manner. If $switch_A$ **92** is open, the "A" signal is held high exhibiting a voltage relative to the voltage source V_{cc}. If $switch_A$ **92** is closed, the "A" signal is pulled low as a result of the short created by closing $switch_A$ **92**. In a similar manner, if $switch_B$ **94** is open, the "B" signal is held high exhibiting a voltage relative to the voltage source V_{cc}. If $switch_B$ **94** is closed, the "B" signal is pulled low as a result of the short created by closing $switch_B$ **94**. If switch **90** is open, the "TRAN" signal is held high at Vcc. On the other hand, if the thumb wheel 13 is depressed transaxially causing the switch **90** to close, the "TRAN" signal is pulled low.

FIG. **6** illustrates a timing diagram of the the "A" signal **102** and the "B" signal **104** where the wheel portion **13a** is rotated in the clockwise direction. Initially, at time t_O $switch_A$ **92** is open (i.e., OFF) and thus the "A" signal is high, and $switch_B$ **94** is closed (i.e., ON) and "B" signal is low. After 6° of rotation of the wheel portion **13a** in the clockwise direction, at time t_1, $switch_A$ **92** is still closed and thus the "A" signal is still high. Also, at time t_1, $switch_B$ **94** opens thus sending the "B" signal high. After another 6° degrees of rotation in the clockwise direction, at time t_2, $switch_A$ **92** closes. At time t_2, switch B remains open and thus the "B" signal remains high. After another 6° degrees of rotation of the wheel portion **13a**, at time t_3, $switch_A$ **92** remains closed and accordingly the "A" signal remains low. At time t_3, $switch_B$ closes and sends the "B" signal low. After another 6° of rotation in the clockwise direction, at time t_4, the end of the period for both the "A" and "B" signals are reached. At time t_4, $switch_A$ opens and sends the "A" signal high, and $switch_B$ remains closed with the "B" signal still low. The processor **44**, by comparing the phase difference between the "A" and "B" signals, can determine that the "A" signal leads the "B" signal which corresponds to clockwise movement of the wheel portion **13a**.

Correspondingly, if the wheel portion **13a** was moving in the counter clockwise direction, the processor **44** would determine that the "B" signals leads the "A" signal by the above process and thus ascertain that the wheel portion **13a** of the thumb wheel **13** is being rotated counter clockwise.

Turning now to FIG. 7, the details of the process carried out by the processor **44** in which the system of the present invention determines that the wheel portion **13a** has been moved and where the processor **44** performs a routine corresponding to the movement is described.

Beginning in step **150**, the processor **44** starts power-on and general initializations as part of the overall initializations of the processor **44**. Such initializations are conventionally known and are not further discussed for sake of brevity. In steps **152** and **154**, the interrupt generator **64** passively monitors the mobile terminal **10** for any thumb wheel **13** movement by sensing a change in the state of the A, B and/or TRAN signals. If the wheel portion **13a** has been rotated or transaxially moved, the process proceeds to step **160**. In step **160**, the interrupt generator **64** generates an interrupt request signal which is provided to the interrupt handler **66**. If the wheel portion **13a** has not been rotated or transaxially moved, the process continues to loop through step **154**. In step **170**, in response to movement of the wheel portion **13a**, the interrupt generator **64** generates an interrupt request and sends an interrupt request to an interrupt handler **66**. Following step **160**, the process then advances to step **170** where the interrupt handler **66** informs the processor **44** that an interrupt relating to movement of the thumb wheel **13** has occurred.

It is to be understood that the interrupt handler **66** may also be used to handle interrupts generated by tie other devices of the mobile terminal **10** such as the display driver **46**, the bar code reader **22**, the operator input device **18**, etc. However, such handling of devices by the interrupt handler **66** is conventional and therefore further discussion in relation thereto is not necessary for an understanding of the present invention.

After the processor **44** has teen informed that an interrupt relating to movement of the thumb wheel **13** has occurred, the process progresses to step **190** where the processor **44** determines via the I/O port **60** by the process described above what type movement (i.e., clockwise rotation, counterclockwise rotation, and/or transaxial movement) of the thumb wheel has occurred. In step **200**, the processor **44** is programmed to perform a particular routine (described in greater detail below) corresponding to the particular movement of the thumb wheel **13**. Next, after the processor **44** has performed the particular routine, the processor in step **210** clears the interrupt (corresponding to the routine just performed) stored in the interrupt handler. Then, the processor returns to step **152** to repeat the process.

FIGS. 8A–8E represent various screen displays of functions, executable by the mobile terminal, which can be selected by a user via the thumb wheel **13** in accordance with the exemplary emobodiment of the present invention. FIG. 8A illustrates the display screen **14** of the mobile terminal **10**. The display screen **14** displays N functions (wherein N is the number of functions) that are executable by the mobile terminal **10**. It is understood that the display screen **14** may also display N items (wherein N is the number of items). However, for ease of understanding, the following discussion will be presented in connection with functions executable by the mobile terminal **10**.

A user holding the mobile terminal can scroll among the functions ($FUNCTION_1$ TO $FUNCTION_N$) by using either the scroll keys **20***a* and **20***b* or using the thumb wheel **13**. For instance, in the present embodiment, $FUNCTION_1$ represents a scan operation. In other words, by depressing the thumb wheel **13** in a transaxial direction while a cursor is located at $FUNCTION_1$ the mobile device **10** will activate circuitry associated with the bar code scanner **22** in order that a bar coded label can be read. By rotating the wheel portion **13***a* of the thumb wheel **13** clockwise, the processor **44** is programmed to cause the screen cursor to scroll downward among other functions in response to the output signals from the thumb wheel **13**. By rotating the wheel portion **13***a* of the thumb wheel **13** counter clockwise, the processor **44** will cause the screen cursor to scroll upward among the functions in response to the output signals from the thumb wheel **13**. If the cursor, for example, is at FUNCTION, the user by rotating the wheel portion **13***a* of the thumb wheel **13** clockwise a predefined number of detents (or clicks) will move the cursor down to $FUNCTION_2$. If the user instead rotates the wheel portion **13***a* counter clockwise predefined number of detents, the cursor will move from $FUNCTION_1$ (at the top of the screen) to $FUNCTION_N$ (at the bottom of the screen). Likewise, if the cursor were at $FUNCTION_N$ (at the bottom of the screen) and the wheel portion **13***a* was rotated in the clockwise direction, the cursor would rollover to $FUNCTION_1$ (at the top of the screen) or perhaps remain at $FUNCTION_N$.

Turning now to FIG. **8**B, the screen display **14** is shown with $FUNCTION_2$ selected by the cursor. By the user depressing the wheel portion **13***a* of the thumb wheel **13** transaxially toward the mobile terminal **10**, the processor **44** detects the change in the TRAN signal from the thumb wheel **13** so as to determine that $FUNCTION_2$ is selected by the user. In response, the processor **44** is programmed to cause the screen illustrated in FIG. **8**C to be displayed. This screen displays functions $FUNCTION_{2i}$ through $FUNCTION_{2N}$ (wherein N is the number of functions). These functions are sub-functions of $FUNCTION_2$ shown on the previous screen in FIG. **8**B. In the manner described above, the user can scroll through these functions by rotating the wheel portion **13***a* clockwise or counter clockwise. Once the user has positioned the cursor to a desired sub-function, he or she can then select that sub-function by depressing the thumb wheel **13** in the manner described above.

To exit from the sub-menu, one of the available sub-function selections may be a return to main menu function. Additionally, however, the present embodiment may also provide an additional double "click" function to allow for more efficient user operations. The double click feature will take on different roles depending on what screen the user is on currently. For instance, in the present embodiment a double click (or in other words the depression of the thumb wheel **13** transaxially two times in a row in a relatively short period of time (i.e. less then one second)) which occurs while a user is in a sub-menu will automatically take the user back to the prior menu screen. If, however, the user is already on the first screen, a double click will take the user to a predefined function which is used repetitively. In this particular embodiment, the repetitive function is the scan function, and thus a double click while on the main menu would automatically re-activate the scanning operations of the mobile device **10**. In order to account for the double click function, the processor **42** of the mobile device is programmed to wait for a predetermined period of time slightly longer then an amount of time given in which successive clicks are recognized as a double click, prior to processing a single click. In this manner, the processor **42** will not accidentally begin processing a single click command until sufficient time has passed to ensure that the first click is not the first of a successive double click request by the user. As the time requirement for initiating a double click will typically be very short (i.e. approximately one second) virtually no system delay is noticeable by a user.

FIG. **8**D shows the screen display **14** with $FUNCTION_5$ selected by the cursor. By the user depressing the thumb wheel **13** transaxially toward the mobile terminal **10**, $FUNCTION_5$ is selected and the screen illustrated in FIG. **8**E is displayed. This screen displays sub-functions $FUNCTION_{5i}$ through $FUNCTION_{5N}$ (wherein N is the number of functions). These functions are sub-functions of $FUNCTION_5$ shown on the previous screen in FIG. **8**D. In the manner described above, the user can scroll through these sub-functions by rotating the wheel portion **13***a* of the thumb wheel **13** clockwise or counter clockwise. Once the user has positioned the cursor to a desired sub-function, he can then select that sub-function by deperessing the thumb wheel **13** in the manner described above.

The functions that are selectable from the screen are functions that are executable by the mobile terminal **10**. Since the mobile terminal **10** is user programmable, executable functions can be added, deleted and/or modified. The executable functions can vary depending on the environment in which the mobile terminal **10** is being used. For instance, if the mobile terminal **10** is being used in a warehouse environment, some of the functions may include: (1) an inventory function; (2) a production lot size function; (3) reorder level function; (4) a safety stock function, etc. Sub-functions of the inventory function, for example, might include: (1i) a total relevant inventory cost function; (1ii) an ordering cost function; (1iii) a marginal cost function, etc.

If the mobile terminal **10** is being used in a medical environment, than upon scanning a patient's ID tag, the first screen display may include a patient name and his/her medical history chart. The next screen may display various features relating to that particular patient as sub functions. The sub functions might include, for example: (5i) the patient's age; (5ii) his or her sex; (5iii) present illness; (5iv) last blood pressure reading; (5v) last weight reading, etc.

As mentioned before, the scroll keys **20***a* and **20***b* along with the select key **20***c* can be used to accomplish the above scrolling and selection. However, using such keys would occupy both hands of a user (i.e., one to hold the terminal and one to press the respective keys). On the other hand, the thumb wheel **13** of the present invention would permit a user to hold the mobile terminal **10** in one hand and with the same hand accomplish the same scrolling and selecting via the thumb wheel **13**.

Although the invention has been shown and described with respect to certain preferred embodiments, it is obvious that equivalents and modifications will occur to others skilled in the art upon the reading and understanding of the specification. For example, the present invention has been described with respect to a user visually identifying a desired function by way of the screen display **14** and the cursor. However, it will be appreciated that the present invention has utility with respect to a different tone being emitted as the cursor scrolls up or down the screen display. For instance, the tone may become higher in pitch as the cursor moves downward in response to clockwise rotation of the wheel portion **13***a* of the thumb wheel **13** by the user. As a result, a user familiar with the different tones and the corresponding function or item associated therewith could